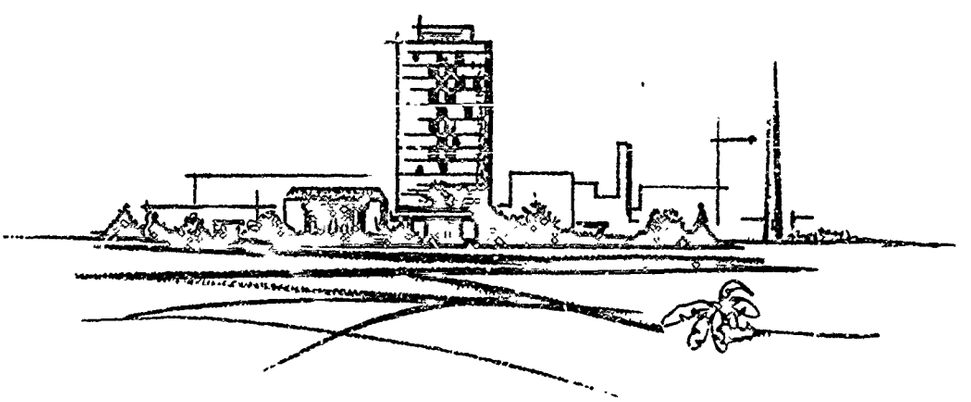
RESEARCH REPORT



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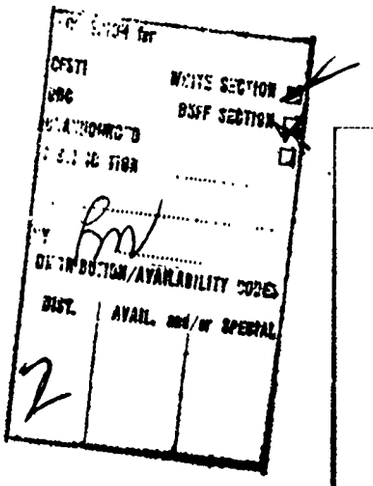

FIELDS OF RESEARCH

Aeronautics — Astronautics
Agricultural Chemistry
Agricultural Economics
Alloy Development
Applied Mathematics
Area Economics
Biochemistry
Biophysics — Bionics
Catalysis — Surface Chemistry
Ceramics
Chemical Engineering
Chemical Processes
Communications Science
Computer Technology
Corrosion Technology
Earth — Atmospheric Sciences
Electrochemistry
Electronics
Energy Conversion
Engineering — Structural Materials
Environmental Systems
Extractive Metallurgy
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Ferrous Metallurgy
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Foundry Practice
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Metal Fabrication Engineering
Metal Finishing
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Nucleonics
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Organic Coatings
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Sound — Vibration
Systems Engineering
Textiles — Fibers
Theoretical — Applied Mechanics
Thermodynamics
Transportation
Welding — Metals-Joining Technology
Wood — Forest Products

(9) FINAL REPORT.

(6) HIGH-TEMPERATURE PROPERTIES AND ALLOYING BEHAVIOR OF THE REFRACTORY PLATINUM-GROUP METALS.

(15) Contract Nonr-2547(00), (16) NR-039-067

to

OFFICE OF NAVAL RESEARCH

December 17, 1965 (11) 17 Dec 65,

(12) 4p.

by

(10) Peter S. Rudman.
Metal Science Group

BATTELLE MEMORIAL INSTITUTE
COLUMBUS LABORATORIES
505 King Avenue
Columbus, Ohio 43201

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505 KING AVENUE COLUMBUS, OHIO 43201 · AREA CODE 614, TELEPHONE 299-3151 · CABLE ADDRESS: BATMIN

December 17, 1965

Dr. W. G. Rauch
Acting Head, Metallurgy Branch
Office of Naval Research
Department of the Navy
Washington, D.C. 20025

Dear Dr. Rauch:

Contract Nonr-2547(00), NR 039-067

Enclosed are two copies of the Final Report on the project, "High-Temperature Properties and Alloying Behavior of the Refractory Platinum-Group Metals".

Please let me know if you have any questions or comments concerning the information in this report.

Very truly yours,

Peter S. Rudman

Peter S. Rudman
Fellow
Metal Science Group

PSR:tam
In duplicate
Enc. (2)

cc: Mr. Edward P. Shute (2)
ONR Resident Representative

HIGH-TEMPERATURE PROPERTIES AND ALLOYING BEHAVIOR OF THE REFRACTORY PLATINUM-GROUP METALS

by

P. S. Rudman
Metal Science Group

The occurrence of many phases in platinum-group metal alloys, or even more generally in transition metal alloys, correlates amazingly simply with electron/atom ratio or as we have preferred to call it, group number. One example is the HCP structure that occurs in alloys in the average group number range 7-8.5. The axial ratio, c/a, ~~has been found to be~~ was a sensitive measure of the electronic state. ~~We have determined~~ The c/a-composition relationship in some 20 HCP alloys containing platinum-group metals was determined. The axial ratio appears to correlate well with phase stability: the smaller the axial ratio, the more stable the phase, with the HCP phase becoming unstable relative to cubic phases as c/a approaches 1.61.

However, group number is not the only structure determining factor. Atomic size is also very important. The Laves phases appeared to be examples of where atomic size plays an important structure determining role. A theoretical study of Laves phases based on an elastic model was performed. This study appears to furnish some insight into the origin of Laves structures and sets the groundwork for a study of their stability.

Before we can hope to understand the structural changes that occur on alloying, we surely must understand the origin of allotropism in pure metals. Accordingly, a theoretical study of allotropism was initiated and is continuing. This study ~~has been~~ was very productive in providing clues to the phase-stabilizing factors. It has been tentatively concluded that the low temperature phases are generally characterized by a high density of states at the Fermi level and that the high temperature phases are characterized by high vibrational entropies.

Publications in 1965

P. S. Rudman, "The Atomic Volumes of the Metallic Elements", Trans. AIME, 233, 864-872 (1965).

P. S. Rudman, "Atomic Volume in Laves Phases: A Hemisubstitutional Solid-Solution Elastic Model", Trans. AIME, 233, 872-878 (1965).

P. S. Rudman, "Lattice Parameters of Tantalum-Osmium Alloys", J. Less-Common Metals, 9, 77-79 (1965).